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Neil Rogers

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Preliminary report on the stratigraphy and structure of the Bee Lake greenstone belt, Superior Province, northwestern Ontario[1]

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Abstract: The Bee Lake greenstone belt consists of a relatively simple volcano-sedimentary stratigraphic sequence that has undergone two folding events and subsequent brittle-ductile faulting. These rocks have been intruded by several generations of dykes and plutons that, once dated, will allow the timing of deformation to be constrained.

The supracrustal sequence consists of basal massive basaltic flows, pillow basalt, and pillow breccia, which are overlain by felsic volcaniclastic and epiclastic tuff and breccia that are locally interbedded with arkosic or quartzose wacke and conglomerate. Locally the conglomerate contains boulder-sized clasts of granodiorite that has undergone little to no pre-entrainment deformation.

Previously the Bee Lake greenstone belt has been correlated with the Confederation assemblage. However, the noticeably different rock types and stratigraphy between this region and the type section for the Confederation assemblage suggest that this correlation is invalid.

Résumé : La ceinture de roches vertes de Bee Lake est constituée d'une séquence stratigraphique volcano-sédimentaire relativement simple qui a connu deux périodes de plissement puis une période de formation de failles cassantes et ductiles. Ces roches ont été recoupées par plusieurs générations de dykes et de plutons dont la datation permettra d'établir la chronologie de la déformation.

La séquence supracrustale est constituée de coulées basaltiques massives de base et de basalte et brèche en coussins que recouvrent du tuf et de la brèche volcanoclastiques felsiques et épiclastiques intercalés localement dans du conglomérat et du wacke arkosique ou quartzeux. Par endroits, le conglomérat contient des fragments de granodiorite de la taille d'un gros bloc, qui ont subi peu ou aucune déformation avant que le processus d'entraînement ne soit enclenché.

Une corrélation a déjà été établie entre la ceinture de roches vertes de Bee Lake et l'assemblage de Confederation. Cependant, les différences manifestes observées dans les types de roche et la lithostratigraphie entre cette région et le stratotype de l'assemblage de Confederation laissent supposer que cette corrélation n'est pas valable.

[1] Contribution to the Western Superior NATMAP Project

INTRODUCTION

The Bee Lake greenstone belt is situated in the Uchi Subprovince of the Superior Province (Fig. 1), approximately 120 km north-northwest of Kenora. This belt of supracrustal rocks represents the extension of the Rice Lake greenstone belt of Manitoba into Ontario. The Bee Lake greenstone belt extends over an area of approximately 170 km^2, bounded to the west by the Manitoba–Ontario interprovincial border at a latitude of approximately 50°40'N (Fig. 1, 2).

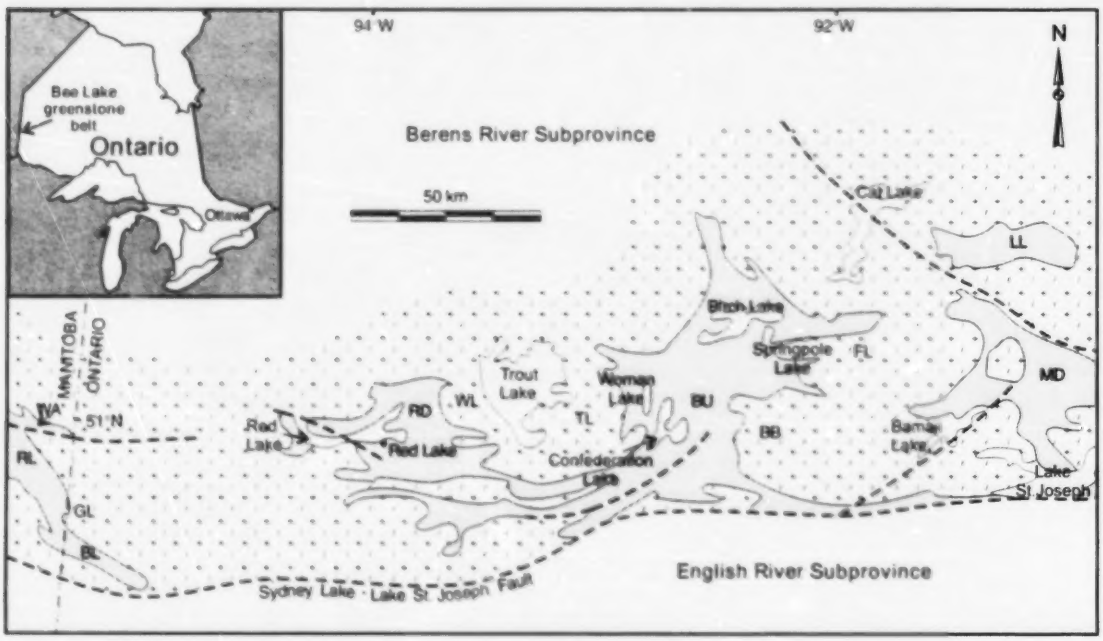
The survey for this report was undertaken during a five-week period in the summer of 2000. Field data were collected primarily along shoreline sections supplemented by traverses as required.

There are no residents in the area, although several of the lakes have hunting and/or fishing cabins. Access is by float plane from Minaki (45 km north of Kenora). The topography of the area is characterized by low relief with numerous generally small lakes. Drainage is to the west via the Manigotagan (Anderson, Bee, Eden, Odd, Rickaby, and Wingiskus lakes) and Oiseau (Chase, Eagle, Kangaroo, and Midway lakes) rivers.

The primary reason for this study was to provide a linkage between recent work undertaken on the Uchi Subprovince in Manitoba (e.g. Sasseville and Tomlinson, 2000; Percival and Whalen, 2000) and farther east in Ontario (e.g. Rogers et al., 1999, 2000; Sanborn-Barrie et al., 2000).

PREVIOUS WORK

Because of its small size and the lack of easy access, very little recent work has been done on the Bee Lake greenstone belt. Shklanka (1967) conducted the primary mapping of the belt. This work was reinterpreted by Stott and Corfu (1991), in part on the basis of assumptions derived from more recent work on adjacent rocks in Manitoba (e.g. McRitchie and Weber, 1971; Weber, 1971a, b; Poulsen et al., 1986; Turek et al., 1989). Additionally, a structural study was conducted around the



	Felsic intrusive rocks	BB	Bamaji-Blackstone batholith	MD	Meen-Dempster belt
	Volcanic and sedimentary rocks	BL	Bee Lake belt	RD	Red Lake belt
	Fault	BU	Birch-Uchi belt	RL	Rice Lake belt
	Geological boundary	FL	Fawcett Lake batholith	TL	Trout Lake batholith
		GL	Gem Lake area	WA	Wallace Lake area
		LL	Lang Lake belt	WL	Walsh Lake pluton

Figure 1. *Regional map of the Uchi Subprovince in northwestern Ontario and eastern Manitoba.*

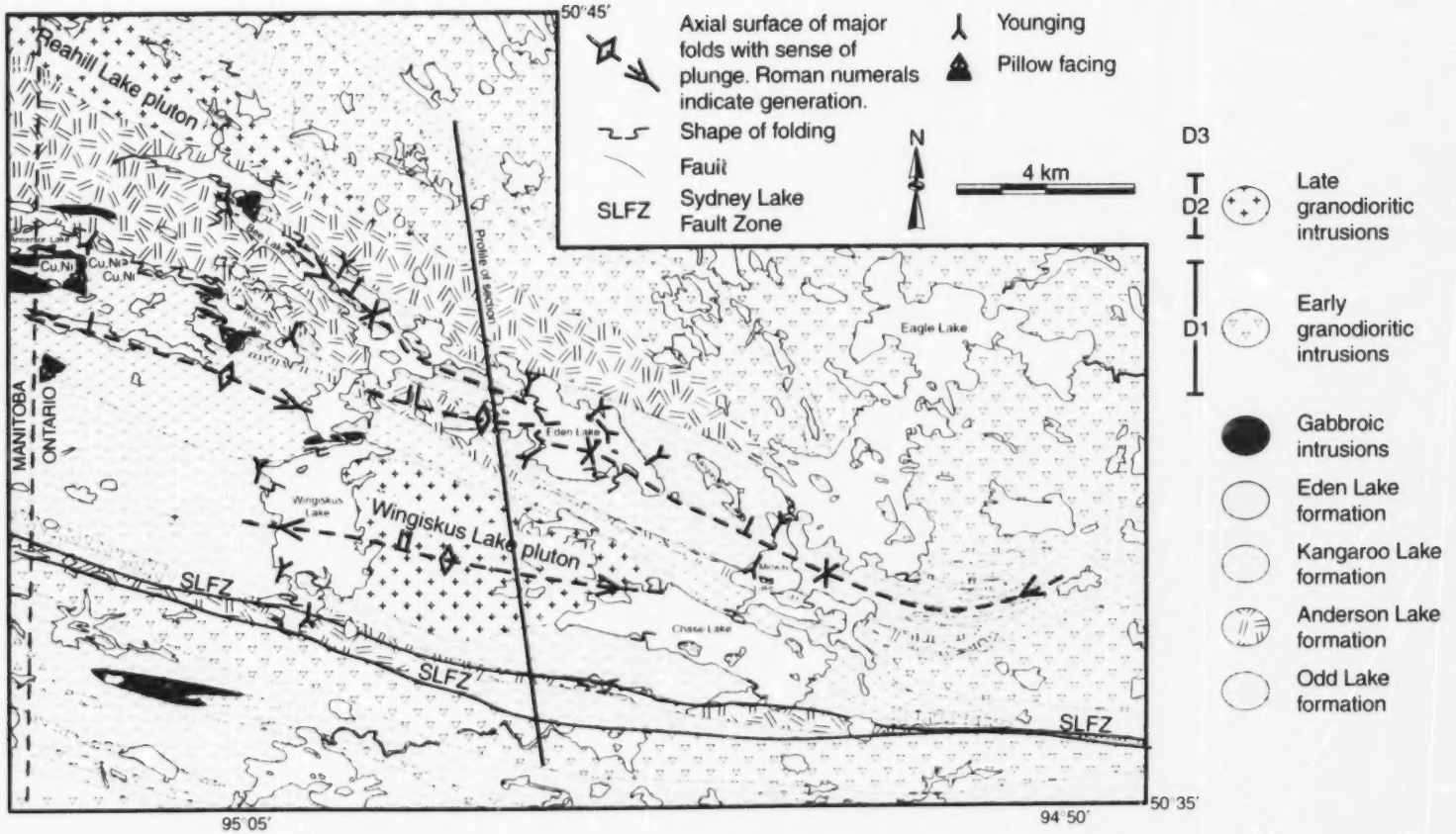


Figure 2. *Bedrock geology of the Bee Lake greenstone belt.*

Chase Lake area (Fig. 2) as part of an investigation into the Uchi–English River Subprovince boundary (Borowik, 1998). No geochemical data or radiogenic dates are available.

Shklanka (1967) interpreted the supracrustal sequence to consist of complexly interbedded sedimentary and volcanic rocks that form a steeply dipping monoclinal succession striking west-northwest and younging south. This succession was therefore believed to represent the southern limb of a regional anticline, the axis of which would have occurred somewhere to the north. This model required the succession to thicken markedly from east to west and have numerous lateral facies variations.

Stott and Corfu (1991) reinterpreted the stratigraphy as an upside-down sequence, such that the main part of the belt formed an antiformal syncline, plunging to the southeast. In contrast, Borowik (1998) suggested either that the Chase Lake area consisted of an overturned tight anticline, the hinge of which is refolded by a later generation of folds, or the local distribution of rock units is controlled by thrust repetitions.

LITHOLOGY AND STRATIGRAPHY

The supracrustal sequence is informally subdivided here into the following four formations, from stratigraphic base upward: Odd Lake, Anderson Lake, Kangaroo Lake, and Eden Lake (Fig. 2, 3). Local facies variations account for the restricted distribution of the Anderson Lake and Eden Lake formations, such that in places the stratigraphy consists solely of the Odd Lake formation overlain by the Kangaroo Lake formation.

The supracrustal rocks are intruded by at least two phases of granodioritic intrusions. The first of these is represented in part by several pulses of dykes that subsequently have been transposed almost parallel to bedding. The distribution of these dykes is shown in Figure 4.

Odd Lake formation

The Odd Lake formation (Fig. 2) represents a mafic volcanic sequence, consisting largely of massive to pillowed basaltic flows (Fig. 5A) along with minor pillow breccia and mafic tuff. In the northern part of the map area, quartz wacke to lithic-arkosic siltstone is interbedded with the mafic volcanic rocks. Subvolcanic diabase to gabbro intrusions are common, particularly in the Anderson Lake area.

The pillowed to massive mafic flows are commonly amygdaloidal, with calcite and/or quartz amygdales. Pillow basalt is most abundant, but not restricted to the vicinity of Odd Lake. Pillows are only rarely identified in the northern or eastern parts of the Odd Lake formation, probably because of the masking of volcanic textures by metamorphism and tectonism (*see* below). In most cases, pillow development and/or preservation is insufficient to enable younging to be determined. Highly porphyritic basaltic flows (containing up to 30 volume per cent plagioclase phenocrysts) are restricted to the southern end of Eagle Lake.

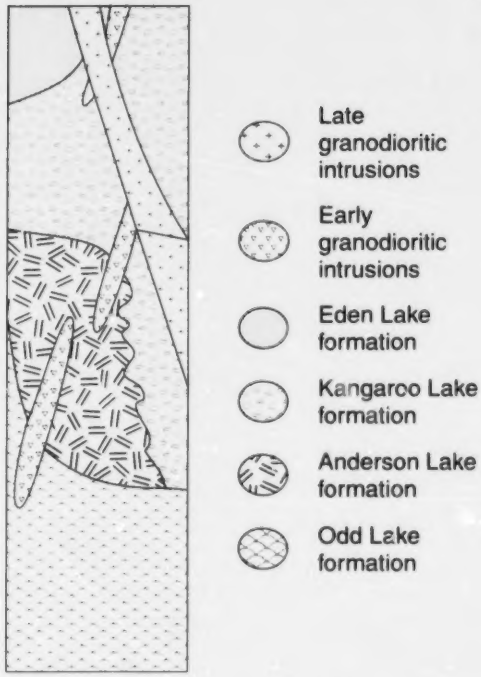


Figure 3. *Summary stratigraphic column for the Bee Lake greenstone belt.*

The Odd Lake formation ranges from mid-greenschist grade in the Odd Lake area to upper amphibolite grade north of Reahill Lake. Greenschist-facies rocks are typically grey-green, blue-green, or greenish black, with a grain size less than 0.3 mm. The main mineral phases are chlorite, epidote, albite, and carbonate. Foliations are generally well developed. Amphibolite-grade rocks are greenish black to black and are slightly coarser (up to 0.8 mm) in grain size than greenschist-facies rocks. The main mineral phases are amphibole, biotite, epidote, plagioclase, and carbonate. Strain is generally moderate to strong, resulting in prominent foliation development.

Anderson Lake formation

The Anderson Lake formation (Fig. 2) constitutes the main body of felsic volcanic rocks within the Bee Lake greenstone belt. Its thickness varies considerably and it becomes extremely thin or absent in the east and south central parts of the region. It consists mostly of felsic volcaniclastic to epiclastic tuff (Fig. 5B) and breccia that are locally interbedded with quartz wacke and/or arkosic sandstone. Felsic flows are rare, with the best developed example occurring at the northern end of Bee Lake. Flow banding is very well developed in this flow (Fig. 5C). It is interesting to note that this felsic flow is adjacent to a small band of Odd Lake formation pillow basalt. Structural facing indicates that this basalt does not represent an inverted keel of the underlying strata, but was deposited with the Anderson Lake rocks, although

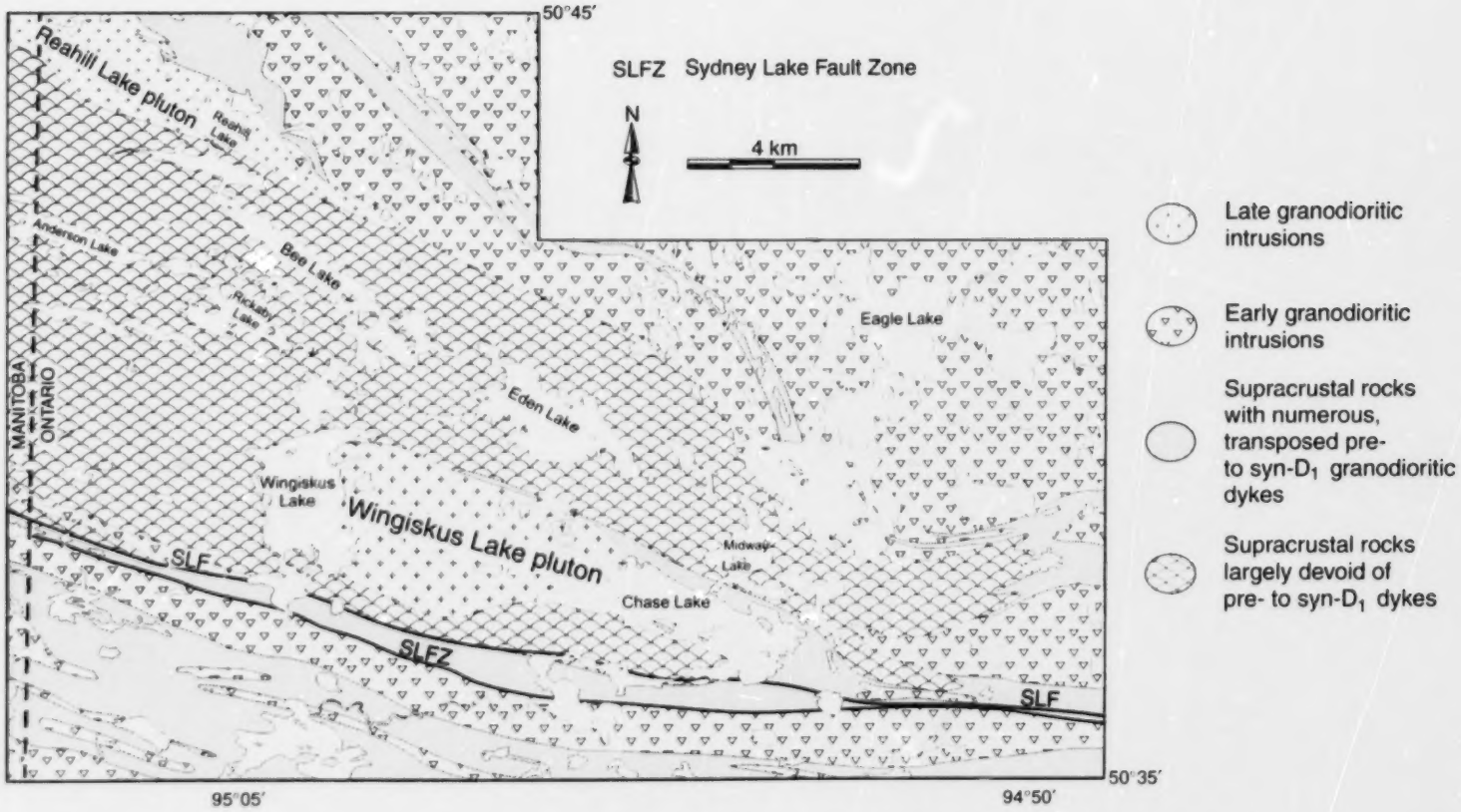
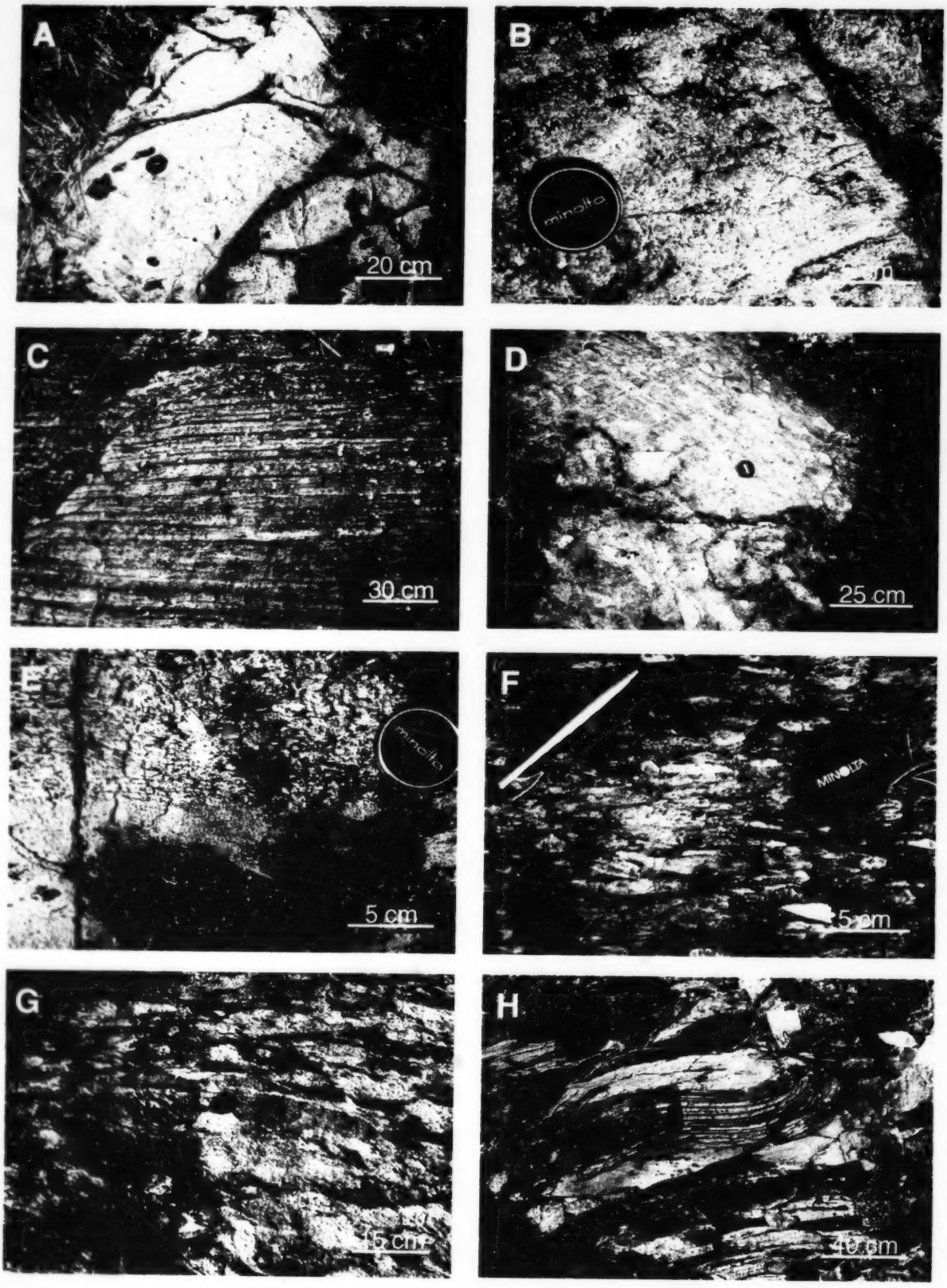


Figure 4. *Distribution map of pre- to syn-D_1 granitic dykes in the Bee Lake region.*


A
20 cm
B
minolta
C
30 cm
D
25 cm
E
minolta
5 cm
F
MINOLTA
5 cm
G
5 cm
H

structural repetition by brittle faulting cannot be discounted completely. The association of felsic and pillowed mafic flows suggests proximity to a subaqueous vent.

Crystal tuff is the dominant rock type in the Anderson Lake formation, although lithic and lapilli tuff is also common. The tuff has a fine-grained groundmass (less than 0.5 mm in diameter) consisting mostly of feldspar and quartz, with minor chlorite, biotite, and white mica, plus or minus carbonate and epidote. Lithic clasts invariably consist of felsic volcanic detritus. The felsic tuff weathers to light grey, but is grey to dark grey on fresh surfaces; it is poorly foliated.

The other major rock type of the Anderson Lake formation is a felsic volcanic breccia (Fig. 5D) that contains moderately well rounded pebble- to cobble-sized clasts that are compositionally indistinguishable from the surrounding Anderson Lake tuff and flows. Generally the clasts are matrix supported and account for approximately 40 volume per cent of the overall rock. The groundmass is slightly more mafic than the surrounding tuff, containing a higher percentage of biotite, chlorite, and epidote. It is unclear whether this compositional difference is primary or reflects concentration of metasomatic fluids into the permeable breccia groundmass. This volcanic breccia is very poorly sorted, although a very crude reversed grading in the distribution of the large clasts has been observed locally. Foliation development is very poor, such that the fabric in the rock is frequently limited to a slight elongation of the clasts. The rounding of the clasts and poor sorting of the volcanic detritus suggests that this breccia formed as epiclastic, viscous, mass-flow deposits. The presence of contemporaneous volcanic debris indicates that they are lahars. Lahars are laminar flows with a cohesive particle–fluid strength, and as such tend to develop reverse size gradation of clasts.

Figure 5. ***A)*** *Pillow basalts in the Odd Lake formation, Rickaby Lake;* ***B)*** *felsic tuff in the Anderson Lake formation, north end of Bee Lake;* ***C)*** *Anderson Lake formation flow-banded rhyolite, Bee Lake;* ***D)*** *epiclastic viscous flow breccia (lahar) from the Anderson Lake formation, southern Bee Lake; possible crudely developed reverse grading of the large clasts;* ***E)*** *bedded arkosic wacke of the Kangaroo Lake formation, with well developed grading; Eden Lake;* ***F)*** *Kangaroo Lake formation pebble conglomerate; rhyolite, granite, and vein quartz clasts are very common, whereas basaltic clasts are rare; note the elongation along the* D_1 *fabric and the slight warping of the clasts by* D_2 *(pen is orientated along* D_2*);* ***G)*** *matrix-supported boulder breccia, Kangaroo Lake formation, Midway Lake; most clasts are of undeformed granodiorite, although some amphibolite clasts also occur;* ***H)*** *iron-formation within the Kangaroo Lake formation, Eden Lake; the open folds are* D_2 *structures.*

Kangaroo Lake formation

The Kangaroo Lake formation (Fig. 2) is composed mostly of arkosic to quartzose wacke and conglomerate (Fig. 5E). It also contains a well defined band of iron-formation that extends between Bee and Eden lakes. This unit largely overlies the Anderson Lake formation, although it is locally coeval (Fig. 3).

Feldspathic and biotite-hornblende-feldspathic quartzose wacke is the most abundant unit in the Kangaroo Lake formation. This siltstone to fine-grained sandstone (less than 0.4 mm grain size) is grey to dark grey and weathers grey or brown. Foliations are generally moderately to well developed and, where evident, beds are commonly in the order of 1 to 5 cm thick.

The main section of arkosic wacke and conglomerate occurs between Eden and Midway lakes. It becomes thin and locally interbedded with the Anderson Lake felsic volcanic tuff on Bee Lake, indicating that the two units are partly coeval. As the arkosic rocks are relatively juvenile deposits derived from a felsic source, the relatively thick section between Eden and Midway lakes may represent the reworked equivalent to the Anderson Lake tuff.

The arkosic wacke is dark grey to black on fresh surfaces, but weathers very light with a distinctive 'gritty' appearance. Quartz and feldspar are the main mineral phases with minor biotite, white mica, epidote, chlorite, and carbonate. Foliations are poorly developed because of the equigranular grains. Normal grading occurs locally and is generally weak, although channel bedding and scours help in determining the way up. Conglomerate lenses occur throughout the sequence and range from several centimetres to tens of metres thick. The conglomerate groundmass is indistinguishable from the surrounding wacke. Clasts are mostly moderately to well rounded and very poorly sorted, and range from 0.5 to 15 cm in diameter. Clast composition includes, in approximate order of abundance, felsic volcanic rocks, siltstone, granodiorite, jasper, vein quartz, and amphibolitic basalt (Fig. 5F).

A lens of boulder breccia is developed between Midway and Eagle lakes. The boulder-sized clasts are matrix supported with an arkosic groundmass (Fig. 5G). The clasts are subangular to moderately well rounded and are generally between 15 and 50 cm in diameter. Granodioritic to granitic clasts predominate (over 70% of the clasts) and include pink, grey, aplitic, massive, and phyric varieties. A pre-entrainment fabric was identified in only one clast and may have a magmatic origin. Smaller amphibolite clasts also occur. This boulder breccia is presumably a coarse equivalent to the arkosic conglomerate that occurs as lenses to the west.

Argillite occurs as rare thin beds within wacke, except in association with the iron-formation on Bee and Eden lakes (Fig. 5H). The thickness of the iron-formation–argillite sequence varies considerably, but is on average about 20 m. The argillite is thinly bedded, greenish-grey to black, and has a prominent foliation. The iron-formation is black, well bedded, and of magnetite type. Individual beds are rarely over 5 cm thick. This sequence also includes thin beds and/or lenses of black chert, jasper, and arkosic siltstone.

Eden Lake formation

The Eden Lake formation (Fig. 2) is restricted to Bee and Eden lakes. In this sequence, it forms the uppermost part of the stratigraphic section (Fig. 3). However, it cannot be proven that the Kangaroo Lake formation is not coeval with or even younger than the Eden Lake formation in other parts of the Bee Lake greenstone belt, as we do not know whether its restricted distribution is a primary feature or relates to the erosion level.

Petrographically the Eden Lake formation closely resembles the Anderson Lake formation, except that it has a higher proportion of very fine-grained, ashy, felsic volcanic tuff and very few epiclastic debris flows (lahars). In general, except for its stratigraphic position, it could not be distinguished from the Anderson Lake formation in the field. Hence, whether the felsic volcanic tuff that occurs within the Sydney Lake Fault Zone (Fig. 2) belongs to the Anderson Lake formation or the Eden Lake formation is unknown.

Early granitic intrusions

Early granitic intrusions consist mostly of gneissic granodiorite, with minor quartz diorite, quartz monzonite, and possible tonalite. They occur as distinct, mappable bodies mainly in the north, northeast, and south (Fig. 2). However, related dykes intrude the supracrustal rocks throughout a significant part of the area (Fig. 4). All these rocks have well developed foliations and grain sizes varying from 1 to 10 mm.

Early granitic intrusions in the southern part of the region are mostly biotite and biotite-muscovite granodiorite. The large bodies typically are light grey, although locally the dykes are red-brown. In the north and northeast parts of the region, early granitic intrusions are mostly hornblende-biotite granodiorite; the main differences between these rocks and the southern intrusions are the presence of hornblende and the lack of muscovite. The northern and northeastern intrusions typically are light grey to buff-yellow and locally contain pinkish-orange aplite dykes.

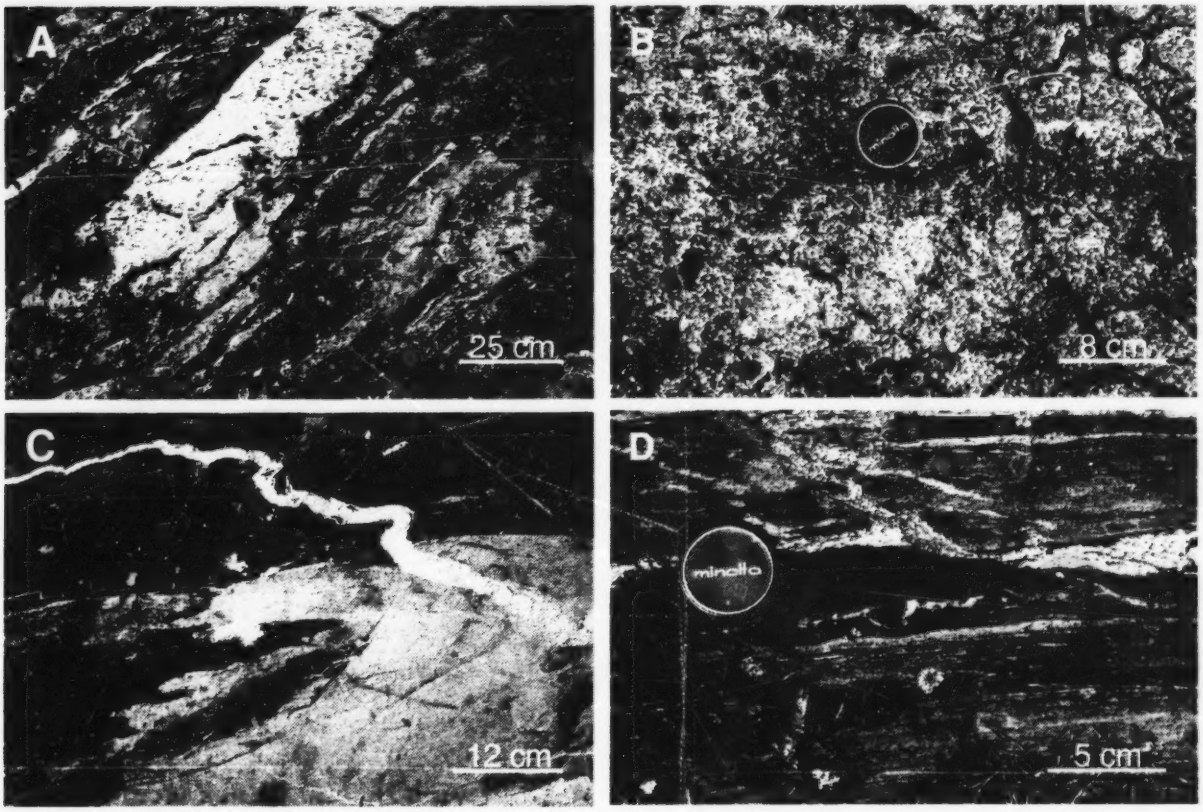


Figure 6. *A) Transposed granodioritic dykes intruding siltstone of the Kangaroo Lake formation, southern end of Wingiskus Lake;* ***B)*** *late, largely undeformed (syn-D_2) granodioritic to quartz monzonitic intrusive; Reahill Lake pluton;* ***C)*** *amphibolitic basalt intruded by multiple phases of granodioritic to tonalite dykes that are progressively deformed by D_1 (S-folds) and subsequently D_2 (Z-folds);* ***D)*** *boudinaged tourmaline vein in sinistrally sheared interbedded basic amphibolite and siltstone, with granodioritic dyke transposed subparallel to bedding; these are cut by a late (post-D_2), dextral, brittle-ductile shear.*

In zones of granitic dyking (Fig. 4), dykes account for approximately 50% of the total volume of the rock, although they represent between 10% and 90% of this volume. They are invariably transposed subparallel to bedding and are demonstrably crosscutting only in parasitic fold hinges. Contacts with the supracrustal rocks are usually sharp, with the size of the intrusions varying from stringers a few millimetres wide to bodies over 40 m thick (Fig. 6A).

Late granitic rocks

Late granitic rocks include the hornblende-biotite-quartz monozonitic to granodioritic Wingiskus Lake pluton and the muscovite-biotite-quartz monozonitic to granodioritic Reahill Lake pluton (Fig. 2). In addition, several small granitic bodies and dykes related to the Wingiskus Lake pluton occur between Anderson and Chase lakes. Foliation is vague to absent in both the Wingiskus Lake and Reahill Lake plutons. Both plutons are typically massive and coarse grained, although rare aplite dykes are also present (Fig. 6B).

STRUCTURAL GEOLOGY

The Bee Lake greenstone belt has undergone two ductile deformation (predominantly folding) events (referred to herein as D_1 and D_2), as well as subsequent brittle to brittle-ductile faulting. In the absence of geochronological data, the timing of these deformation events is constrained only relative to the various phases of granitic intrusion.

The D_1 event is the most pervasive in the Bee Lake greenstone belt. In general, it produces a prominent, bedding-parallel foliation that is axial planar to doubly plunging, tight to isoclinal, northwest-trending folds. The northern limb of the synclinal structure centred between Bee and Midway lakes is vertical to slightly overturned to the south (Fig. 2, 7). The corresponding anticline is centred on Odd Lake. Significant shearing is also evident during D_1, locally resulting in narrow (less than 4 m wide) mylonite zones. Where the sense of motion was apparent, these mylonite zones were kinematically consistent with the fold geometry, implying that they are sheared fold limbs. The D_1 mylonite zones do not appear to be regionally significant and have been traced only up to 1 km along strike. However, as they are so narrow, they could be far more extensive and may locally cause structural

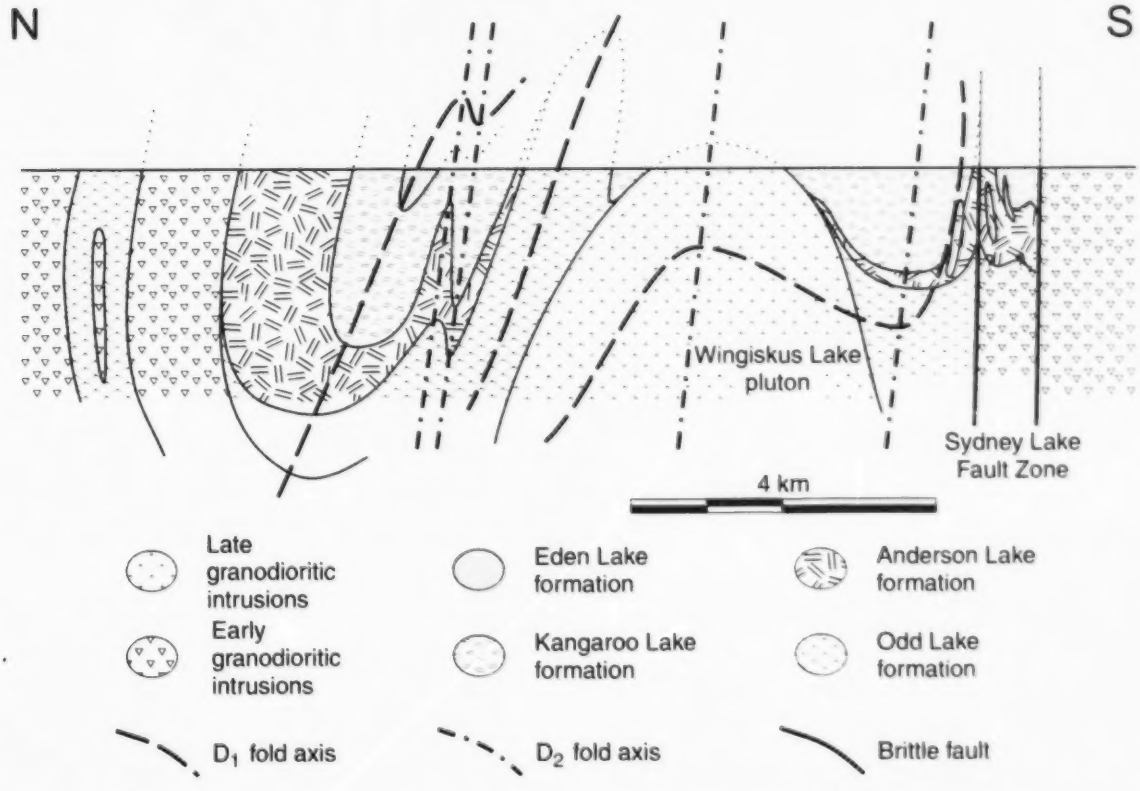


Figure 7. *Schematic cross-section through the Bee Lake greenstone belt (not to scale). The projection of this profile is shown on Figure 2.*

repetitions. Therefore, whether these shear zones are partly responsible for the apparent rapid thinning and thickening of formations across the region is unknown.

The extent of D_1 shearing is illustrated by the subparallel transposition of early granitic dykes (Fig. 4, 6A). Locally, several phases of crosscutting dykes are present. For example, at the narrows between Chase and Midway lakes, four phases of intrusion are identified within a single outcrop (Fig 6C), the first three phases of which are pre- to syn-D_1. The earliest dyke is transposed to within 2° of the D_1 foliation. The two subsequent dykes are progressively less transposed, but both have D_1 foliations and parasitic S-folds. The youngest dyke transects (i.e. postdates) the D_1 fabric, but is folded by D_2 (Z-folds). This indicates that the D_1 event consisted of at least three pulses of folding, interspersed with phases of granitic intrusion.

The D_2 folding event formed generally open, upright, east- to east-northeast-trending folds, synchronous with the intrusion of the Wingiskus Lake pluton that forms the core of a D_2 dome between Wingiskus and Chase lakes (Fig. 2, 7). No foliations where observed within the Reahill Lake pluton, but the pluton's map pattern and the deflection of the D_1 fabric around it indicate that it also syn-D_2.

Minor conjugate brittle to brittle-ductile faults and shear bands trending northeast and east-northeast occur within every unit in the Bee Lake greenstone belt (Fig. 6D). Their orientation is consistent with their being related to the Sydney Lake Fault Zone at the southern margin of the belt (Fig. 2). In this region, the Sydney Lake Fault Zone consists of at least two discrete faults (Fig. 2). These faults were not observed directly, but can be mapped to within 5 m because of a significant southerly jump in metamorphic grade across them. No Sydney Lake Fault Zone mylonite was recognized and therefore it is assumed that the Sydney Lake Fault Zone is largely brittle in this region. The surface profile of the Sydney Lake Fault Zone and the jump in metamorphic grade across it indicate that it is vertical with a south-side-up component of motion. Assuming that the conjugate faults are related, it follows that the Sydney Lake Fault Zone is dextral overall.

ECONOMIC GEOLOGY

Most past economic interest in the Bee Lake greenstone belt has been centred on quartz-vein-hosted gold. The gold is found primarily in association with pyrite, chalcopyrite, arsenopyrite, galena, scheelite, and/or iron carbonates. The thickness of the quartz veins is mostly less than 5 cm, but can reach 2.5 m. At least two generations of quartz veins were identified, with the gold-bearing veins being the younger phase (Shklanka, 1967). Most of the reported assays from these veins have shown only small quantities of gold (Shklanka, 1967).

Several copper-nickel showings have been recognized in the Anderson Lake area (Fig. 2). They occur in gabbro bodies (that are relatively large for the region), near their interface with the host basaltic rocks. The showings consist of discontinuous bands of disseminated sulphide, commonly within minor shear zones. The sulphides consist mainly of chalcopyrite, pyrrhotite and pyrite, and typically run at substantially less than 2% combined copper and nickel (Shklanka, 1967). Although these sulphide showings are not economically viable for copper or nickel, it is worth noting that low copper-nickel-content disseminated sulphides hosted in shears near a gabbro margin are consistent with a platinum-group-element (PGE) deposit. No recent assays are available for the area, so it is unlikely that the PGE potential has ever been tested.

SUMMARY AND CONCLUSIONS

The Bee Lake greenstone belt has a relatively simple stratigraphy that progresses from basaltic volcanic rocks at the base to largely volcaniclastic and epiclastic felsic volcanic and clastic sedimentary rocks. These rocks are cut by at least two generations of granitic intrusions, each of which is broadly synchronous with a ductile deformation event. All the units are affected by brittle or brittle-ductile faults that are probably related to the Sydney Lake Fault Zone, which has a maximum age of ca. 2700 Ma (F. Corfu, unpub. data, 1989).

Stott and Corfu (1991) correlated the Bee Lake supracrustal sequence to the Confederation assemblage. Even though the overall stratigraphic sequence of basaltic to felsic volcanic rocks is the same as in some parts of the Confederation assemblage in the Birch-Uchi (Rogers et al., 1999, 2000) and Red Lake (Sanborn-Barrie et al., 2000) greenstone belts, the detailed petrographic characteristics are very different. One of the distinctive features of the Confederation assemblage at the Birch-Uchi and Red Lake greenstone belts is the presence of FIII rhyolite (Lesher et al., 1986). Although this rhyolite is primarily defined by its whole-rock trace-element profiles (Lesher et al., 1986), it has distinct petrographic characteristics (dark grey to black, cherty, and often perlitic) that enable it to be identifie fairly easily in the field (Rogers et al., 1999, 2000). No FIII rhyolite has been recognized in the Bee Lake greenstone belt. Similarly, the FII rhyolite (Lesher et al., 1986) in the Birch-Uchi and Red Lake greenstone belts is typically welded ignimbrite (Rogers et al., 1999, 2000; T. Skulski, pers. comm., 2000), and such rocks are unknown in the Bee Lake region. Consequently, the correlation of the Bee Lake greenstone belt with the Confederation assemblage seems unlikely. However, this cannot be tested until geochronological and geochemical analyses have been undertaken.

The presence of massive pink granodiorite clasts within the breccia of the Kangaroo Lake formation suggests that the supracrustal sequence is Neoarchean, as such intrusive rocks are generally younger than ca. 2750 Ma. A possible age for the Bee Lake greenstone belt comes from the adjacent Gem Lake area of southeastern Manitoba where a felsic tuff from the Gem Lake Subgroup (Rice Lake Group) has yielded a ca. 2721 Ma U-Pb zircon age (D. Davis, unpub. data, 1994). This age is significantly younger than the Confederation assemblage, but is coeval with the bimodal volcanism of the St. Joseph assemblage farther east in the Uchi Subprovince (Stott and Corfu, 1991).

The Gem Lake Subgroup was defined by Weber (1971a) as consisting of a basic to felsic extrusive sequence that is partly intercalated and overlain by clastic sedimentary rocks. The Gem Lake volcanic rocks are attributed to the Banksian Lake Formation. The basal basalt is mostly pillowed with local occurrences of massive, highly plagioclase-porphyritic (possibly andesitic) units. The Gem Lake felsic volcanic rocks are largely crystal or lapilli tuff and volcanic breccia, with rare flow-banded rhyolite. The intercalated and overlaying sedimentary rocks belong to the Rathall Lake Formation and consist of boulder conglomerate, gritty wacke, and arkose. Hence, the Gem Lake Subgroup stratigraphy is closely comparable to that of the Bee Lake greenstone belt.

Without geochronological data, it is impossible to make reliable estimates of the age of deformation. However, the style of deformation exhibited by D_1 (map-scale folds associated with narrow bands of shearing occurring during several discrete pulses of deformation) seems similar to that of the D_2 event (otherwise referred to as the 'Kenoran Orogeny') identified in the Red Lake greenstone belt (M. Sanborn-Barrie, pers. comm., 2000). If this structural comparison is correct, then it would give D_1 an age of ca. 2718 Ma.

The apparent absence of both FII and, particularly, FIII rhyolite indicates that the potential for volcanogenic massive sulphide (VMS) deposits is very low within the Bee Lake greenstone belt, as almost all VMS deposits in the Superior Province are related to these rock types (Lesher et al., 1986). However, chemical analyses are required to rule out that FII and/or FIII rhyolite is present, but has atypical petrographic characteristics.

Quartz-vein-hosted gold occurs across the region, but its presence is patchy and the known occurrences are low grade and/or too small to be economically significant. The relationship of the gold to the youngest generation of quartz veins indicates that the gold was introduced late in the history of the belt.

Although the VMS and gold potential of the region seems to be low, some gabbroic bodies do have a potential for PGE mineralization. The development of low-grade, copper-nickel sulphides in shear zones at the margin of a gabbro fits the profile for PGE hosts. However, this possibility needs to be tested chemically, as PGE-bearing gabbro generally has a reduced composition.

Geochronological and geochemical analyses are underway. Firstly, the supracrustal sequence will be dated and its chemical composition defined. This should address possible correlations between the Bee Lake greenstone belt and the other parts of the Uchi Subprovince. Subsequently, some intrusive phases will be dated to constrain the ages of deformation.

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